Proposal

Economic Impact of Marine Aquaculture

Prepared for:

Department of Marine Resources

June 10, 2003

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I.

INTRODUCTION

1. BACKGROUND

Maine is the leading marine aquaculture producer in the United States, with total farm-gate sales exceeding $100 million in 2000. The industry operates just over 100 lease sites (±45 finfish, ±35 shellfish, ±25 experimental), supported by 10-15 hatcheries. Salmon is the dominant species (±$90 million), while mussel and oyster lead shellfish production (±$10 million).

All of Maine's coastal counties support at least some aquaculture, with operations concentrated in Washington, Hancock and Lincoln Counties. Like aquaculture elsewhere, the industry has forged important backward and forward linkages with the broader economy. Hatcheries, feed companies and equipment suppliers represent the main backward linkages, while forward linkages include processing, transportation and marketing. One estimate places total industry employment in the range of about 1,000 full time equivalent jobs.

Growth and development in the industry over the past decade are very encouraging. The value of output has increased, and a wider range of species is being produced or is under development. But achieving viability and sustainable growth are not without their challenges. Among these are optimizing the use of the natural environment, while managing key factors influencing growth: regulatory environment, investment climate, research and development, labor and skill requirements, and market intelligence.

2. STUDY OBJECTIVE

Timely and comprehensive information on the aquaculture sector is needed to gain a better understanding of these factors and to create solutions that promote development and growth. To this end, the Maine Department of Marine Resources (DMR) is seeking an analysis of the economics of the industry. The specific objective is to produce a report that:

- **analyzes the present and future economic impact and business viability of marine aquaculture in the State.**

To meet this objective, the consultant must gather and assess a substantial body of economic information about the industry, and the challenges and opportunities it faces.

3. THE CONSULTANTS

Gardner Pinfold, working closely with Aquaculture Management Services Inc., is pleased to submit this proposal. We have extensive experience in the aquaculture sector in the Gulf of Maine, and are confident our proposed methodology and work program will result in a study meeting the stated requirements and objective.

- **Gardner Pinfold,** of Halifax, is recognized as one of Canada's leading fisheries consultants with over 20 years experience as advisors to government and industry on a wide range of economic, policy and regulatory issues. Gardner Pinfold specializes in the economic analysis of marine fisheries and aquaculture and the challenges facing their development and growth. The company operates from offices in Nova Scotia and British Columbia.

- **Aquaculture Management Services Inc. (AMSI)** offers a broad range of business and technical consulting services in the finfish aquaculture and traditional fisheries sectors. Andrew Storey, company President, has over 20 years experience in the industry and is able to provide clients with effective and integrated solutions concerning issues ranging from raw materials to end users. AMSI specializes in the development of intensive, industrial scale aquaculture, as well as the application and integration of new technology. The company operates out of Saint John, New Brunswick, with international contacts and experience.

Gardner Pinfold and AMSI have collaborated successfully on projects in the past, and enjoy an excellent working relationship. Examples of their work are included with this submission.

The examples provided have direct relevance to the questions of economic impact and aquaculture viability in the waters of the Gulf of Maine. They also provide an indication of the breadth and depth of analysis of our work, and the innovative ways in which results are presented.

II.

TECHNICAL PROPOSAL

1. OVERVIEW

Our technical proposal addresses several requirements set out in the terms of reference. It describes the methods we propose to use to gather and analyze data, outlines the tasks we need to carry out to implement the methodology, and provides an overview of the deliverables and how we propose to package these into a report.

2. METHODOLOGY

Our proposed methodology is a mix of qualitative and quantitative techniques. In general, we will use qualitative techniques (interview, survey and focus group) to gather data for the economic impact analysis and the growth projections. Economic impact will be estimated using an Input-Output (I-O) Model, while growth will be projected using spreadsheet simulations developed specifically for this study. A clear descriptive narrative setting out assumptions, reasoning and conclusions will accompany both aspects of the work. Any technical material will be included in an appendix.

Economic Impact

Quantifying the economic impact of marine aquaculture serves to highlight the relative significance of the industry, and provides a basis for development planning. We will rely on several indicators to measure impact:

- **Industry profile:** We will compile detailed information allowing an economic profile of the industry to be developed. As a first step we will agree with DMR on a definition of the industry. We would propose that a broad definition be adopted, one that considers the industry as an integrated operation composed of three main components: hatcheries, grow-out operations and processing facilities. The profile will set out for each component the number, type, and size range (in terms of employment and production) of enterprises organized by species. It will include a map indicating the geographic distribution of enterprises. It will also indicate total production (quantity and value), product forms and principal and secondary markets.

- **Markets and distribution chains:** We will compile and present market information, showing quantity and value of production (by species and product) by destination within the US and to export markets. We will also trace product through distribution channels, showing price development at each stage from final consumption to primary production.

- **Direct employment:** This will be quantified in terms of persons and full-time equivalent jobs, with information obtained directly from producers. We will classify employment into two categories: management and administration (owners and salaried personnel), and operations (wage-earning production employees).

- **Direct income:** This will be quantified in dollar terms, divided into salary and wage components. This is a key cost element that will be used to drive the I-O Model.

- **Gross sales and value:** This will be quantified in dollar terms, and also in physical terms (weight) to facilitate production comparisons over time that are isolated from fluctuations in market prices. We will obtain information at the farm gate and also from value added enterprises.

- **Costs:** These fall into three main categories – capital, operating, and research and development. Accurate and comprehensive information on costs is crucial to estimating economic impacts since it is these costs that are used to drive the I-O Model. We will obtain detailed costs from each component of the industry, ensuring these are consistent with the commodity categories needed to drive the model. Where necessary, we will rely on cost data from our recent studies on New Brunswick and Nova Scotia operations.

- **Economic impact:** Estimating economic impact relies on detailed cost information obtained from industry to drive an I-O Model. We propose to use either the Regional Economic Model (REMI) maintained by the Centre of Business and Economic Research, or the Regional Input-Output Modeling System (RIMS II) operated by the Bureau of Economic Analysis. Both quantify the impact indicators specified in the Terms of Reference: dollar value of outputs of goods and services by industry, direct and indirect employment, and direct and indirect earnings. They also generate multipliers so that so-called induced effects (changes brought about by spending and re-spending household income) can be determined. Direct, indirect and induced employment and income are added to derive the overall impact of the aquaculture industry in Maine. It is worth noting that economic impacts can be estimated on a state-wide basis, or can be confined to the coastal counties. Direction on the preferred model and approach will be obtained from DMR.

Results will be presented by sector (finfish and shellfish), and by species where possible and relevant. All results will be summarized in clear tables and diagrams.

Viability and Growth Projections

We will prepare two growth projections: short-term (2-5 years) and long-term (10 years). These will project potential growth of two variables: number of farms and their viability (by sector and species), and production level (in terms of quantity and value). Given the number of factors that bear on viability and growth and the uncertainty surrounding the direction and strength of their influence, we will develop growth projections not as single points, but as falling within likely ranges.

Projecting growth breaks down into a notional four-step process:

- Identifying key factors and how they have affected viability and growth in the past. This is a matter of reviewing each factor and its influence on aquaculture development. Information for this review will be obtained through interviews with producers and other industry stakeholders. Key factors include:

    - **Suitable habitat:** This will allow an upper limit of production to be estimated using known biophysical requirements and accepted assumptions on stocking density, carrying capacity and technology;
    - **Market conditions:** This will allow price trends to be established based on how demand and supply by species are expected to develop over the projection period, and on Maine's competitive position in the market;
    - **Regulatory environment:** The relative complexity and cost of the lease process, terms and conditions of required permits, and stringency of environmental obligations are factors affecting rate of development and viability;
    - **Technological change:** Emerging technologies (e.g., offshore salmon cages) may allow areas of otherwise suitable but unusable habitat to become available for aquaculture, thereby enlarging the potential area for farming, improving viability, and increasing production levels;
    - **Access to research and development:** Advances in R&D could address two of the main limiting factors facing aquaculture in Maine - cold water and short growing seasons;
    - **Access to capital:** Outside sources of capital are key to success because many farmers exhaust their limited finances in the R&D or commercialization stages of their operations, but access to capital can be difficult given the risks aquaculture presents (market, environment, threat of disease);
    - **Labor availability:** What steps are needed to facilitate the response of coastal communities to increased demand for workers with higher and more diverse skill sets as aquaculture continues to introduce more sophisticated technologies and is required to meet more stringent environmental standards;
    - **Community support:** Though a welcome source of employment and income for some, aquaculture carries negative connotations for others because, for them, the floats and cages diminish coastal beauty thereby threatening tourism potential and property values;
    - **Environment:** As the recent case demonstrates, the aquaculture industry (primarily finfish producers) faces substantial economic challenges in meeting increasingly stringent environmental standards;
    - **Others:** These will be identified in the course of interviews.

- Assessing how each factor is likely to change over the projection periods. This is a matter of looking forward to see how factors are likely to change. Perspectives on the future will be developed through interviews with stakeholders, coupled with the consultant's own expertise on these issues. The latter will be particularly important for such factors as emerging technologies, market conditions, and effects on environment.

- Estimating how viability and growth are likely to be affected by key factors. The next step is to apply the conclusions about changes in factors to the growth indicators: number of farms, output and viability. Each factor could have one of three influences: positive, negative or neutral. We will work through the analysis of each, providing a first approximation estimate about short-term and long-term effects on viability and growth. These projections would form the lower limit of the growth range.

- Determining what action could be taken to enhance viability and growth. The final step is to recommend actions to mitigate the effects of factors constraining growth, and to reinforce those that support it. These recommendations would be based on stakeholder views and experience elsewhere. The net effect on growth arising from action on these recommendations would form the upper limit on the growth projection range.

Business viability is an essential underpinning for growth, and hence for the growth projections. Assessing viability can be carried out in either non-quantitative or quantitative terms. The non-quantitative assessment for each species would rely on information and opinions provided by producers, combined with the consultant's knowledge. This is referred to in the Cost Proposal as Option 1.

The quantitative assessment would require a formal financial analysis for each species – a cost of production analysis using actual data, combined with price and production assumptions to allow computation of an internal rate of return. An example of this approach is contained in our report, *Nova Scotia Aquaculture: Comparative Analysis of Development Issues and Economic Potential of Selected Species*, included as part of this submission. This is referred to in the Cost Proposal as Option 2.

The Terms of Reference are unclear about which approach is to be used. The difference between them lies in the level of effort required, with the quantitative analysis requiring more. In view of the uncertainty about which approach is required, our cost proposal presents two options.

Data Gathering

The cost information needed to conduct the economic impact analysis will be gathered through interviews, and supplemented through a survey. The interviews will be conducted with a representative sample of producers within each species group. A structured interview guide will be used. The objective is to determine the cost structure of production systems for each species, allowing estimation of cost coefficients linked to production levels (e.g., feed and labor requirements, wage costs per pound of salmon).

These coefficients would then be applied to industry production totals obtained through a survey of all producers to determine overall costs, employment levels, income, etc.

Information to support the growth analysis will be obtained from stakeholders through interviews and focus group sessions. Stakeholders include producers, government officials in the technical support and regulatory areas, environmental and community organizations, financial institutions, universities and research institutes, and buyers and distributors of aquaculture products. They will be interviewed in person or by telephone using a structured interview guide. Recommendations on actions to promote growth will be developed through 2-3 focus group sessions, each involving a range of stakeholders.

Details of data gathering follow. Exact numbers by will be determined through discussions with DMR.

	Interviews	Survey
Producers	20-25	all those not interviewed
Service and supply	15-20	-
Government/regulatory	5-7	-
Organizations/institutions	5-7	-

3. PROPOSED WORK PROGRAM

Our proposed Work Program is divided into five distinct tasks. Given the detail in which the Methodology is described, the tasks are presented in point form.

TASK 1: PROJECT START-UP

Activities

We will meet with DMR to:

- Review our proposal to ensure we have a common understanding of the proposed study and its deliverables;
- Determine contact points, reporting relationships, meeting schedules and administrative arrangements; and,
- Obtain contact details for producers and others, and agree on an interview and survey plan.

Outputs

The main outputs of Task 1 are:

- A common understanding of the study scope and deliverables;
- The information needed to commence the data gathering; and,
- Agreement on administrative arrangements.

TASK 2: GATHER AQUACULTURE ECONOMIC DATA

Activities

- Specify data requirements;
- Prepare interview guide and submit to DMR for review and comment;
- Select and contact representative sample of aquaculture sector interviewees (20-25 interviews, stratified by species);
- Circulate interview guide before interviews (this guide will also contain questions pertaining to viability and growth outlined in Task 3);
- Administer questionnaire through in-person interviews;
- Compile results.

Outputs

- Raw data needed to drive economic model and estimate impacts.

TASK 3: ASSESS VIABILITY AND DEVELOP GROWTH PROJECTIONS

Activities

- Identify and review with DMR key factors affecting viability and growth;
- Prepare interview guide and submit to DMR for review and comment;
- Select and contact stakeholder interviewees (25-35 interviews of stakeholders not interviewed in Task 2);
- Conduct interviews (to avoid interviewing producers twice, questions pertaining to viability and growth will be included also in the producer interviews under Task 2);
- Compile results;
- Conduct analysis of viability, opportunities and constraints;
- Assess effects of key factors and develop options for enhancing growth;
- Make recommendations for business development; and,
- Develop 2-5 and 10-year growth projections.

Outputs

- Discussion paper on growth factors with recommendations for development;
- Analysis of viability and growth projections;
- Data to assess economic impact of growth projections.

TASK 4: ESTIMATE ECONOMIC IMPACT(S)

Activities

- Review economic model options with DMR and select model;
- Prepare current data from Task 2 to drive model;
- Prepare data from growth projections (Task 3) to drive model;
- Submit data to model manager;
- Obtain and review current and projected impact results; and,
- Prepare current and projected impact estimate tables.

Outputs

- Industry economic impact at current production levels;
- Industry economic impact at projected production levels.

TASK 5: PREPARE REPORT

Activities

- Meet with DMR (in person or by conference call) to report on progress and to identify any problems or difficulties and how these are being resolved;
- Prepare interim report for review and comment by DMR;
- Prepare draft report
- Prepare final reports taking into consideration DMR comments.

Outputs

- Progress reports;
- Draft report; and,
- Final report.

4. DELIVERABLES AND REPORT OUTLINE

We will produce a report containing five distinct deliverables:

- An economic profile of the Maine aquaculture industry;
- An assessment of the economic impact of the Maine aquaculture industry with its current structure and level of production;
- An assessment of the viability of specific species and production levels in the future;
- A review of factors influencing viability and growth, with recommendations on options to promote growth; and,
- Projections of growth over 2-5 and 10-year periods, with an assessment of the resulting economic impact of the industry.

The proposed table of content for the report is as follows:

I. Introduction
1. Study objectives
2. Approach
3. Report outline

II. Industry Profile
1. Industry development: 1970-2000
2. Current structure and operations
3. Production indicators

III. Industry Viability and Growth
1. Factors affecting growth
2. Options to promote development and growth
3. Growth projections

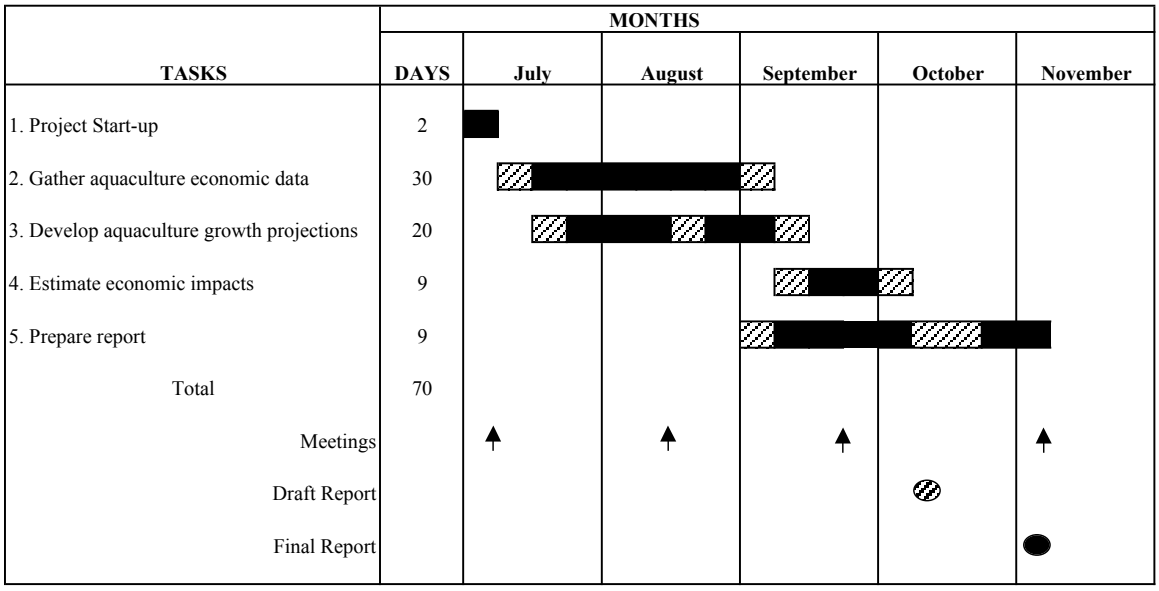
IV. Economic Impact
1. Approach
2. Impact of current industry
3. Impact with growth

V. Recommendations

5. SCHEDULE

The study will be completed over a four-month period, with a draft report delivered no later than October 15, 2003, and a final report by November 15. The schedule showing the relationship of tasks and the overall duration of the study is set out in Figure 1.

Figure 1: Study Schedule – Maine Aquaculture Economic Impact Assessment



III.

STUDY MANAGEMENT

1. STUDY ORGANIZATION

Team Members

The Study Team is composed of two firms and four consultants, bringing to the study the particular strengths and experience needed to carry out the requirements and meet the objectives.

The members and areas or responsibility are:

Gardner Pinfold Consulting Economists Limited

- Michael Gardner, M.A., LL.B. – study manager, methodology, interviews and author
- Robert Fraser, B.A. – interviews and economic analysis
- Mike Milloy, B.A., M.E.S. – interviews and analysis

Aquaculture Management Services Inc.

- Andrew Storey, B.Sc., – advisor on technical and financial viability of production systems, and on challenges and opportunities facing aquaculture

Study Team Selection Criteria

Four main criteria were used in assembling our Study Team:

- Extensive aquaculture experience in the Gulf of Maine with the subject species and technologies, and sound knowledge of industry development opportunities;
- Excellent fisheries and aquaculture consultation and data collection abilities;
- Extensive experience with economic development policy, strategy and support mechanisms in aquaculture and natural resources generally;
- Ability to deliver on time and within budget.

2. TEAM MEMBERS

Michael Gardner

Michael Gardner brings to the project over 20 years experience in natural resource matters, with an emphasis on marine fisheries. He enjoys an excellent reputation for careful, objective and balanced analysis and reporting.

Mr. Gardner's work has addressed virtually every aspect of fishing industry policy, structure, operations, markets, and management in most fisheries in Atlantic Canada. He has also conducted high-level studies of aquaculture development. Extensive consultation with industry stakeholders forms a key element in most of his work. A representative list of studies includes:

- New Brunswick Salmon Aquaculture Infrastructure Requirements
- Nova Scotia Aquaculture: Comparative Analysis of Development Issues and Economic Potential of Selected Species
- Economic Potential of Sea Ranching and Enhancement of Shellfish Species in Canada
- Scallop Development Potential in the State of Maine
- A Study of Seafood Markets and Information Systems Among Member Economies of the Asia-Pacific Economic Cooperation Forum
- Analysis of Global Demand and Supply for Crab Species for FAO
- Economic viability of the Northern Shrimp Fishery (including a market analysis)
- Economic viability of the Arctic Surf Clam Industry (including a market analysis)

Andrew Storey

Andrew Storey brings to this study an intimate knowledge of the aquaculture industry in the Atlantic Provinces and Maine. He will make a major contribution to the analysis of technology and economic viability, as well as the assessment of factors affecting growth and development.

Mr. Storey has been a member of the traditional fisheries and aquaculture industries for over 20 years, specializing in the aquaculture sector for the past 12. Mr. Storey was involved in the early stages of the modern industrial aquaculture industry in New Brunswick, and has intimate knowledge of many of the circumstances contributing to the development and growth of the industry there, and in many other jurisdictions, including Maine. Through Aquaculture Management Services Inc., Mr. Storey is currently involved in some of the leading edge technologies that are helping to shape future strategies for growth.

Robert Fraser

Robert Fraser will conduct interviews and provide economic analysis, including the development of cost data to drive I-O Models. He will also assist with assessment of factors affecting aquaculture growth.

Mr. Fraser also brings to this project over 20 years of consultancy experience, specializing in the economics of natural resource management and development. He has conducted and assisted on numerous fisheries and agriculture studies with Gardner Pinfold - several involving market analysis and viability assessment. Virtually all these situations involve extensive consultation with industry stakeholders. He has also conducted numerous reviews and evaluations of agriculture and forestry policies and programs aimed at supporting enterprises and institutions in those sectors.

Mike Milloy

Mike Milloy will provide support in the interviewing stages of the project and contribute to data analysis for economic impact assessment.

Mr. Milloy brings a multidisciplinary background to the project team and has been involved in many economic developments, impact assessments and natural resource projects. He has extensive experience in many facets of economics and environmental studies, including research coordination, data analysis, conducting interviews and qualitative and quantitative report writing.

Résumés

Résumés for the team members may be found in the Appendix.

3. CORPORATE EXPERIENCE

Gardner Pinfold Consulting Economists Limited

Company Profile

Gardner Pinfold is an independent, Halifax-based company, offering a comprehensive range of economic consultancy services to industry and government.

The firm was created in 1979, drawing on the strengths in economics and law of its principals, Thomas Pinfold, Ph.D. and Michael Gardner, M.A., LL.B. Clients benefit greatly from the excellent conceptual and methodological skills they apply on all projects. During the 1980s, Gardner Pinfold emerged as one of Canada's leading firms in the fields of program evaluation, natural resource development and management, environmental economics, and policy analysis and regulatory review.

The firm enjoys an enviable reputation for addressing complex issues with thorough research and objective analysis, leading to reliable conclusions and thoughtful recommendations. In its nearly 20-year existence, the firm has produced some 400 authoritative reports of consistently high quality, on time and within budget.

Gardner Pinfold serves private and public clients throughout Canada, and is experiencing a growing demand for its services among international agencies delivering technical assistance in developing countries.

Consultancy Services

Methods

- Cost-Benefit Analysis
- Program Evaluation and Analysis
- Feasibility and Project Appraisal
- Legal and Regulatory Analysis
- Sample Survey Design & Analysis
- Cost of Production Studies
- Economic Analysis
- Economic Impact Assessment
- Environmental Economics
- Simulation Modelling

Fields

- Forestry Management
- Fisheries Development and Management
- Aquaculture/Agriculture Development
- Offshore Petroleum Development
- Marine Environment and Coastal Zone
- Transportation Planning
- Regional Development
- International Development
- Rural Development

Aquaculture Management Services Inc.

Company Profile

Aquaculture Management Services Inc. offers a broad range of business and technical consulting services in the finfish aquaculture and traditional fisheries sectors. Andrew Storey, company President, has over 20 years experience in the industry and is able to provide clients with effective and integrated solutions concerning issues ranging from raw materials to end users. AMSI is able to assemble international teams of people to provide specific expertise in a variety of disciplines. Mr. Storey also has expertise in the formation of business networks.

AMSI specializes in the development of intensive, industrial scale aquaculture, as well as the application and integration of new technology. The company operates out of Saint John, New Brunswick with international contacts and experience.

Service/Product Profile

AMSI is currently developing package solutions for the farming of high energy (high current and/or offshore) seawater and freshwater aquaculture cage sites, using advanced large volume cage designs integrated with automated feeding systems. The company also has extensive experience in the North American fresh fish market.

IV.

COST PROPOSAL

1. COST

The cost to complete the work depends on which study option is chosen:

Option 1: $36,900. This is for the complete analysis described in Section II, with viability of production systems by species assessed in non-quantitative terms. In other words, the viability assessment is based on information provided by producers, combined with the knowledge of the consultants.

Option 2: $50,150. This is for the complete analysis described in Section II, with viability of production systems by species assessed in quantitative terms. In other words, the viability assessment is based on a financial analysis (internal rate of return) incorporating detailed capital and operating costs and revenues streams for each species. A sensitivity analysis is included.

OPTION 1: Budget to Conduct Maine Aquaculture Economic Impact Assessment

Days	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Total**
Michael Gardner	1	4	3	2	4	14
Andrew Storey	1	3	2		1	7
Robert Fraser		8	6	3	2	19
Mike Milloy		10	7	3	2	22
Total	2	25	18	8	9	62
Fees						
Michael Gardner @ $700/day	700	2,800	2,100	1,400	2,800	9,800
Andrew Storey @ $700/day	700	2,100	1,400	0	700	4,900
Robert Fraser @ $500/day	0	4,000	3,000	1,500	1,000	9,500
Mike Milloy @$350/day	0	3,500	2,450	1,050	700	7,700
sub-total	1,400	12,400	8,950	3,950	5,200	31,900
Expenses (at cost)						
Travel and accommodation						3,500
Model runs						1,000
Report production						500
sub-total						5,000
Total fees and expenses	1,400	12,400	8,950	3,950	5,200	**$36,900**

OPTION 2: Budget to Conduct Maine Aquaculture Economic Impact Assessment

Days	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Task 5**	**Total**
Michael Gardner	1	4	7	2	4	18
Andrew Storey	1	4	5	1	1	12
Robert Fraser		10	12	3	2	27
Mike Milloy		12	12	3	2	29
Total	2	30	36	9	9	86
Fees						
Michael Gardner @ $700/day	700	2,800	4,900	1,400	2,800	12,600
Andrew Storey @ $700/day	700	2,800	3,500	700	700	8,400
Robert Fraser @ $500/day	0	5,000	6,000	1,500	1,000	13,500
Mike Milloy @$350/day	0	4,200	4,200	1,050	700	10,150
sub-total	1,400	14,800	18,600	4,650	5,200	44,650
Expenses (at cost)						
Travel and accommodation						4,000
Model runs						1,000
Report production						500
sub-total						5,500
Total fees and expenses	1,400	14,800	18,600	4,650	5,200	**$50,150**

2. PERFORMANCE GUARANTEES

With the approval of DMR, invoices will be submitted upon the completion of milestones as follows:

Milestone 1:	Task 1	15%
Milestone 2:	Task 2	25%
Milestone 3:	Task 3	25%
Milestone 4:	Task 4	15%
Milestone 5:	Task 5	20%
Total		**100%**

Invoices will include details of specific days worked by consultant, as well as all expenses.